

Trends and applications of ionizing radiation for preservation of cultural heritage tangible artifacts

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Disinfection of cultural heritage artefacts and archived materials using ionizing radiation has been successfully applied and accepted by the Brazilian conservation and preservation institutions and community in recent years. Several works of art, museum collections artefacts, books, manuscripts, drawings, archive documents, musical instruments, ethnographic objects, archaeological findings and natural history collections have been decontaminated. Several research studies have been developed addressing the behaviour of cellulosic based materials treated with the ionizing radiation. However, many Brazilian collections have objects made from the most diverse constitutive materials and these are affected by biodeterioration. In order to the effective decontamination of the most diverse types of objects there was a need to establish protocols for care of institutions and individuals carrying cultural and historical collections and for the effective processing by ionizing radiation in the facilities respecting the ethical principles of conservation and restoration covering activities from the problem detection to the final cleaning. Additionally, ionizing radiation has allowed the development of innovative nanostructured cross-linked materials, with applicability in cleaning delicate surfaces. This work presents the most recent results of the effect of ionizing radiation on morphology and physicochemical properties of photographic and cinematographic films, featherwork and botanical collections – exsiccate; as well as the protocols developed as a practical guide for conservatives and professionals of the irradiation for treatment of tangible objects. Preliminary results of nanostructured cross-linked polymeric hydrogels for cleaning surface of artworks obtained by ionizing radiation are also presented. The IAEA sponsored projects have helped to increase the acceptance of nuclear technology by the Brazilian society, especially by the community of restorers, curators and conservators of material cultural goods. The research developed and disseminated with the support of IAEA contributes to the understanding that the cultural heritage is the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and restored for the benefit of future generations.

Biographies

Pablo Vasquez is a researcher and R&D manager in the Radiation Technology Center CETER at the Nuclear and Energy Research Institute (IPEN) and professor in the Nuclear Technology Applications Graduation Program at the University of São Paulo (USP). He obtained his PhD in Chemical Engineering and Nuclear Technology at Washington University, St. Louis, and the University of São Paulo. He leads the team working on the research and applications of radiation processing for preservation and conservation of cultural heritage artefacts. He has produced publications on radiation processing, industrial dosimetry, ionizing radiation sterilization, sealed sources industrial applications, materials modification by ionizing radiation and development of gamma irradiation facilities. Vasquez has been an IAEA lecturer and consultant for trainings and projects related to disinfection and consolidation of archived materials and cultural heritage artefacts by radiation processing. He currently participates in IAEA projects related to the development of radiation treatment methodologies and new resin formulations for consolidation and preservation of archived materials and cultural heritage artefacts. He is co-author of the IAEA Radiation Technology Series Book *Uses of Ionizing Radiation for Conservation for Tangible Cultural Heritage*.

Maria J.A. Oliveira is a researcher and Post-Doc at the Nuclear and Energy Research Institute -IPEN. She obtained her M.Sc. in 2008 and her Ph.D. in 2013 in polymeric biomaterials at the University of São Paulo -USP. In 2014, her Ph.D. thesis related to polymeric hydrogels for drug release for the treatment of cutaneous leishmaniasis was elected as the best national and awarded by the Brazilian development agency CAPES. She has great research experience in the development of polymeric biomaterials for the health area including hydrogels with silver nanoparticles for the treatment of wounds, burns. Currently, she is working on the developing of nanostructured hydrogels obtained by ionizing radiation for cleaning and decontamination of surfaces focusing specially on cultural heritage artifacts and archived materials.

Maria Nagai is a researcher and conservation specialist at the University of Sao Paulo -USP. She obtained her M.Sc. in Nuclear Technology Applications at the University of São Paulo – USP. She works with preservation of cultural heritage collections. She has experience in the conservation of institutional collections, with emphasis on disinfection of tangible cultural heritage objects by ionizing radiation, collections and conservation of works on paper and photographic films. She is currently is a Ph.D. student in the Nuclear Technology Graduate Program at Nuclear and Energy Research Institute-IPEN at University of São Paulo- USP.

Ana C.D. Vieira has a bachelor's and master's degree in History from the University of São Paulo -USP and a specialization in conservation of archaeological materials from Yachaywasi Institute of Conservation in Lima, Peru. Since 2008, she is a conservator and responsible for conduct condition surveys of collections and individual items, technical analyses, conservation treatments and preparation of collection items for exhibition, loan, move, and research at the Museum of Archeology and Ethnology -MAE-USP. Her current research interests in topics related to interdisciplinary collaboration, indigenous participations and how the conservators can help to reframe ethnographical traditional museums through collaborative work with originators or descendants of originators of indigenous collections in Brazil. Since 2018 she has been carrying out research projects in association with the Nuclear and Energy Research Institute (IPEN) for the use of ionizing radiation for the preservation of cultural heritage. She is Assistant Coordinator of Working Group Objects from Indigenous and World Cultures de International Council of Museums - Committee for Conservation (ICOM-CC).

Leni Lima is the director of the Technical-Scientific Communication Service at the São Paulo State Forest Institute and has expertise in communication, graphic projects and publishing of printed and digital materials. She is a M.Sc. student inside the Nuclear Technology Program at the Nuclear and Energy Research Institute -IPEN. She obtained her B.Sc. in communication sciences (1989) and specialist in graphic design at Anhembi Morumbi University (2005). She has experience in theory and practice in public enlightenment using multimedia at Okinawa International Center, Japan (2007) and in cultural heritage conservation treatment. She is a researcher in a project of cultural and scientific heritage for preservation of botanical samples in herbaria using ionizing radiation processing.

Paulo Santos holds a B.Sc. degree in Mathematics at University of São Camilo and a M.Sc. degree in Nuclear Technology at the University of São Paulo - USP. He is a researcher at the Nuclear and Energy Research Institute, working with cobalt-60 gamma irradiation devices and facilities and its applications.